Aviagen™ Turkeys

Bulletin

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Water Quality Guidelines for Turkeys

Introduction

Turkeys typically consume twice as much water as feed, so it is important to provide a clean, healthy water supply. Water not only serves as a vital nutrient but it also impacts virtually every physiological function in the body. Therefore factors which might alter water quality such as changes in bacterial content, pH, nitrogen levels, hardness, alkalinity or mineral levels might directly impact water consumption or the bird's ability to utilize consumed water.

The established guidelines for microbial and mineral water quality for poultry are outlined in Table 2: Acceptable Concentrations of Minerals and Organic Matter in Water Supply. This table and the factors outlined below should be used to develop a daily waterline sanitation program applicable for the local conditions of the farm.

Bacteria

The microbial or bacterial test results received from labs are Total Plate Count of Aerobic (oxygen loving) Bacteria (TPC) as measured by CFU/ml (Colony Forming Units/ml). These results do not indicate whether the bacteria present is harmful or harmless but it can tell if the system is dirty and therefore at risk to the presence of less desirable bacteria.

If the total plate count or TPC level is 1000 CFU/ml or less then the water supply is considered acceptable. On farms with excellent water sanitation it is common to see water tests which show 0 CFU/ml even from the end of the drinker line. The closer the water sample results are to 0 CFU/ml the better the water supply is for the modern turkey. Should the test results be greater than 10,000 CFU/ml, it is strongly recommended that the water system be thoroughly cleaned between flocks with an approved cleaner at appropriate concentrations and length of time and then a daily water sanitation program implemented when birds are present.

pH

pH is the measure of how many hydrogen ions are in solution and is measured on a scale of 1 to 14 with 7 being neutral. A pH reading below 7 indicates an acid with the acidity becoming greater as the numbers become closer to 1. Numbers above 7 are in the basic range of the pH scale. Making a pH change of 1 unit makes a 10 fold change in acidity or alkalinity. So a pH of 6 is 10 times more acidic than a pH of 7.

While pH is not a chemical or specific contaminant, it can impact water quality. It impacts the effectiveness of disinfectants such as chlorine. If water has a high pH then it may be necessary to acidify the water in order to create a favorable pH for effective sanitation with chlorine. Chlorine is most effective in the range pH 4 to 7, but loses effectiveness above pH 8.

Hardness

Hardness is a measure of the calcium and magnesium in the water. The biggest problem with these minerals is the scale that they form. Scale can reduce the volume of pipes and impact nipple drinkers. It also reduces the effectiveness of cleaners and disinfectants. A water softener can be used to reduce hardness. However sodium based water softeners should not be used if the water already has a high level of sodium.

Minerals

There is no such thing as pure drinking water as all sources have some amount of minerals dissolved in it. The majority of the time, these dissolved minerals are well within acceptable ranges as the turkey has been shown to be very tolerant of some minerals such as calcium and sodium but very intolerant of minerals such as iron and manganese. Iron and manganese tend to give water a bitter metallic taste and iron also supports microbial growth such as pseudomonas or E. coli. There are many cases of mineral contaminants that are not within desired levels which results in the following issues:

- Poor performance
- Equipment failure or damage
- Presence of harmful bacteria or fungal slime (some minerals can act as a food supply for these).

The minerals calcium and magnesium are the sources of scale, a hard white deposit found in water pipes. If the water supply contains more than 60 ppm of either or both these minerals and the water pH is above 7 then chances are high that there is scale in the water system that will have to be removed with an acid cleaner designed for nipple drinker systems.

Other common mineral contaminants are iron, manganese and sulphur. Iron results in a rusty brown to red colored residue, while manganese and sulphur can form black colored residues. Natural sulphur in the water should have a smell similar to a match head. If the water smells like rotten eggs, then the culprit is hydrogen sulphide. Hydrogen sulphide is a by-product of sulphur loving bacteria and the lines will need to be cleaned with a strong sanitizer. It might even be necessary to shock chlorinate the well

If the filters at the beginning of the water lines are rusty or black colored, then a strong acid cleaner should be used after the sanitizer flush. If iron is a concern, the best method of control is chlorination and filtration.

Nitrates are colorless and odorless and the only way to detect its presence is by testing. As little as 10 ppm nitrate can impact performance causing reduced growth rates and poor feed conversions.

Cleaning Water Lines Between Flocks

Providing a clean, safe and sanitized water supply is crucial in assuring flocks perform their best. Before implementing a daily water sanitation program, it is important to thoroughly clean as much of the water distribution system as possible to remove biofilm, scale and other deposits.

Daily Water Line Sanitation

Cleaning the water lines between flocks is only half the battle. Even with a thorough cleaning, if a significant number of bacteria, fungi or yeasts are still present, then the biofilm has the potential to return completely in 2-3 days. Therefore the last step is to establish a daily water sanitation program. This will benefit both the birds and the water system.

Also many of the popular water additive products such as acids and performance enhancers can create conditions favorable for the growth of yeasts and molds, if they are present. Yeasts and molds can actually thrive in low pH water resulting in a gooey slime that will clog drinkers and generally create disaster in water systems.

Start birds on fresh sanitized water with 3-5 PPM free chlorine residual at the end of the line or in the drinker farthest from chlorine injection. Add a second injector or medicator and inject an approved acid if the pH is too high. This will enhance the effectiveness of the chlorine. Ensure injectors are several feet apart so the first injected product is completely dissolved before the second injection.

Measuring Water Line Sanitation

An important piece of information to know how effective the sanitization program has been is the ORP value of the water. ORP stands for oxidation-reduction potential and it simply refers to the property of sanitizers such as chlorine to be a strong oxidizer. A strong oxidizer literally burns up viruses, bacteria and other organic material present leaving water microbiologically safe.

An ORP value in the range of 650 millivolts or greater indicates good quality water that can be effectively sanitized by as little as 2 to 4 ppm free chlorine. A lower ORP value such as 250 millivolts indicates a heavy organic load that will most likely overwhelm chlorine's ability to properly disinfect the water.

The ORP meter can be a useful tool for identifying water supplies that don't have adequate free chlorine and for adjusting this without overusing chlorine. It is important to measure the free chlorine level in water. Water with a heavy organic load would result in a greater percentage of bound chlorine resulting in a poor sanitization.

The bottom line is utilize information on pH, ORP and chlorine level to determine if the sanitation program is effective and to also prevent equipment damage by the overuse of chemicals.

Do not add chlorine when administering vaccines, medications, or vitamins.

Do not mix chlorine and other products in the same stock solution.

Shock Chlorinating Wells (Anon., 2002)

For shock chlorination, the goal is to achieve 200 parts per million (ppm) chlorine in the system.

- Remove any activated carbon filters that might be in the system to prevent filter damage.
- Household bleach can be used for shock chlorination.
- Approximately 3 pints per 100 gallons will give a 200 ppm solution.
- Caution should be used when handling chlorine compounds and minimize human exposure to chlorine fumes in confined areas such as well houses.

Step 1 Determine the depth of water in the well. It might be necessary to contact the company that drilled the well to get an exact well depth and water level.

Step 2 Determine the volume of water in the well. Measure the inside diameter of the well and then refer to Table 1 to determine gallons per foot of water depth.

Step 3 Estimate the volume of water in the distribution system and then calculate the total amount of water in the system. Plan for at least 50 gallons in the pipelines and also calculate how much is in hot water heaters, holding tanks etc.

Step 4 Determine the amount of chlorine product required for a 200 ppm solution for all of the water in the system.

Step 5 Pour the chlorine mixture into the well and distribution system. Dissolve the amount of chlorine solution needed into a clean 5 gallon plastic bucket and then slowly poor this into the well but splash it onto the well casing when possible. It is recommended that a hose be attached to a nearby water hydrant and this be allowed to drain back into the well. This will help mix the bleach with the well water. Once the solution has been placed in the well, then turn on hydrants and let run until a strong bleach smell is observed. Turn off hydrants and let bleach stand in system for 2-3 hours or overnight if possible.

Step 6 Flush the system to remove the chlorine. The entire system must be emptied of chlorine and thoroughly flushed. Drain the water where it will have a minimal impact on vegetation and animals.

Table 1: Volume of water contained per foot of well depth (Anon. 2002)

Well casing diameter (inches)	Water volume (Gallons/foot of water depth)
4	0.65
6	1.47
8	2.61
10	4.08
12	5.88
18	13.22
24	23.50
30	36.72
36	52.87

Table 2. Acceptable Concentrations of Minerals and Organic Matter in Water Supply

Contaminant, Mineral or Ion	Levels Considered Average	Maximum Acceptable Level	Comments
Bacteria			**Total Bacteria** is used as an indicator of system cleanliness, high numbers do not necessarily mean the bacteria present is harmful but it does mean that the system is capable of harboring pathogenic organisms. High bacteria levels can impact taste of water resulting in reduced consumption.
Total Bacteria (TPC) CFU/ml	0 CFU/ml	1000 CFU/ml	
Total Coliforms	0 CFU/ml	50 CFU/ml	**Treatment**-Shock well, then implement sanitation program such as chlorine, hydrogen peroxide or other sanitizers. Maintain a residual level of sanitizer.
Fecal Coliforms	0CFU/ml	0 CFU/ml	Presence of any **fecal coliform** means water is unfit for consumption.
pH	6.5-7.8	5-8	**pH below 5** can be harmful to drinker equipment-causing corrosion to metal components with long term exposure. **Treatment**-If pH is lower than 5 use soda ash or caustic soda injection to raise pH. **pH above 8**- impacts effectiveness of most water sanitizers. High pH associated with high alkalinity, may result in reduced water consumption due to "bitter" taste. **Treatment**- If pH is high acid injection will be required.
Total Hardness	60-180 mg/l	110 mg/l	**Total Hardness** (Calcium plus Magnesium) causes scale which reduces pipe volume and causes drinkers to be hard to trigger or leak. **Treatment**- Softeners can reduce hardness up to a practical limit of 1 gpg or 17 ppm/mg/l. If the hardness is above 3 gpg or the sodium to hardness ratio is greater than 33% then the sodium level will be high after softening and reverse osmosis may be required.
Natural Elements			
Calcium (Ca)	60 mg/l		Birds are very tolerant of **calcium** but values above 110 mg/l may require water softener, polyphosphates or acidifier to prevent scaling. In areas of high calcium care must be taken to ensure proper calcium/phosphorus ratios for egg production.

Contaminant, Mineral or Ion	Levels Considered Average	Maximum Acceptable Level	Comments
Magnesium (Mg)	14 mg/l	125 mg/l	Higher levels of **magnesium** may cause flushing due to laxative effect particularly if high sulfate is present.
Iron (Fe)	0.2 mg/l	0.3 mg/l	Birds are tolerant of the metallic taste of **iron**. Iron can cause leaking drinkers and promote the growth of E coli and pseudomonas. Iron is linked to thick slime producing bacteria such as crenoforms. **Treatment**- Includes oxidation with chlorine, chlorine dioxide or ozone followed by filtration.
Manganese (Mn)	0.01 mg/l	0.05 mg/l	**Manganese** can result in black grainy residue on filters and in drinkers. **Treatment-** Includes oxidation with chlorine, chlorine dioxide or ozone then filtration. Green sand filtration and softeners will remove manganese. Pay close attention to pH when deciding what method to use. Farms with manganese in the water have been problematic.
Chloride (Cl)	50 mg/l	150 mg/l	**Chloride** when combined with high sodium levels, creates salty water that can act as a laxative causing flushing. Salty water can promote the growth of *Enterococci* organisms that can lead to enteric issues. **Treatment**- Reverse Osmosis, anion exchange resin, lower dietary salt levels, blend source with non-saline water. Keep water clean and use daily sanitizers such as hydrogen peroxide or iodine to prevent microbial growth.
Sulfates (SO_4)	15-40 mg/l	200 mg/l	**Sulfates** can cause flushing in birds. If rotten egg odor is present, then bacteria producing hydrogen sulfide (H_2S) are present. **Treatment**- System will require shock chlorination plus establishment of good daily water sanitation program, sulfates can be removed by reverse osmosis or anion resin. If H_2S is present (the rotten egg smell) then aerate water into a holding tank, treat with sanitizers then filtration.
Nitrates	1-5 mg/l	25 mg/l	High **nitrate** levels can result in poor growth and feed conversion. Presence of nitrates may also indicate fecal contamination therefore testing for bacteria is recommended. **Treatment**- Reverse Osmosis or anion exchange resin.
Lead	0 mg/1	0.014 mg/l	Long term exposure to **lead** can cause weak bones and fertility problems. **Treatment**- Reverse osmosis, softener or activated carbon will greatly reduce lead.
Copper	0.002 mg/l	0.6 mg/l	
Zinc		1.5 mg/l	

References

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Acknowledgements

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